2.0 Regulation Governing Individual Onsite Wastewater Disposal

Design Standard V
Elevated Sand Mound Disposal System

Mississippi State Department of Health
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Mississippi State Department of Health

DESIGN STANDARD V
ELEVATED SAND MOUND

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I. Introduction

These guidelines present requisite site characteristics, design criteria, and construction techniques for on-site mound sewage systems. These guidelines provide a systematic approach to mound system design for typical domestic household wastewater. For systems serving other than single-family dwellings the designer is cautioned that simple extrapolation of this information **may not** be appropriate.

When addressing wastewater flows that differ from a septic tank, such as those characterized by high biological oxygen demand (BOD_5), total suspended solids (TSS), or oil and grease, the elevated sand-mound has inherent limitations. Wastewater from non-domestic sources should be evaluated on a case by case basis, to determine the amount of pretreatment necessary to apply to an elevated sand mound. The waste water applied to an elevated sand mound should not exceed 220 mg/l BOD_5 or 145 mg/l TSS (no TSS particles should be retained on a $1/8^{th}$ inch screen).

Mounds are an excellent treatment and disposal choice on appropriate sites, but they are not very forgiving. Special attention must be given to siting, design, pre-construction planning, site preparation, filter media selection, construction and maintenance of these systems. Quality control throughout the process cannot be overemphasized.

II. General

1. Successful function of any on-site system is characterized by a two-fold process: treatment and disposal. The final treatment is accomplished predominately by physical and microbiological/chemical processes within the soil environment. These processes are affected by:

    a. wastewater strength and characteristics,

    b. soil moisture levels

    c. the nature of the receiving soil, and

    d. the soil loading rate.

2. Disposal is primarily affected by the depth of the unsaturated receiving soils, their hydraulic conductivity, and the area available for disbursement. The mound system relies on a single-pass flow pattern in unsaturated flow conditions through specified filter media (sand) for sewage treatment. The elevated sand-mound system incorporates the disposal component by discharging directly into the underlying soil.

3. A elevated sand-mound system is characterized by:

a. a pretreatment device (a septic tank with an approved filter, or a treatment plant)

b. pressure distribution components (pumping chamber, pump and controls, and distribution laterals.), and

c. the "mound" (fig. 1). The "mound" consists of:

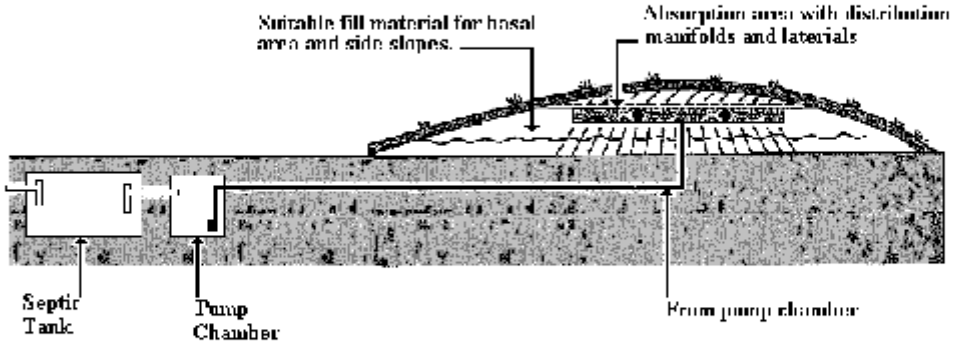
i. filter media (sand),

ii. an absorption area,

iii. a distribution system, and

iv. a soil cap and topsoil cover.

Figure 1



4. A septic tank with an approved filter or a aerobic treatment unit may be used as the pre-treatment for the elevated sand mound. The effluent, pumped from the pump chamber into the distribution network in the absorption bed area, flows through the filter media where it is treated through biological and chemical processes. The treated effluent then passes into the natural soil, that must have at least six (6) inches of unsaturated soil.

III. Pre-Treatment

The preliminary treatment for an elevated sand-mound will be either an aerobic treatment unit or a septic tank with an approved filter. The pre-treatment method selected shall comply with the applicable sections of the Regulation Governing Individual Disposal.

IV. Pumping Chambers

1. The pumping chamber shall have a minimum capacity of 750 gallons or twice the daily flow, whichever is the largest.

2. The pumping chamber shall be equipped with an audible and/or visual high water alarm.

3. The high water alarm must be set to allow a reserve capacity of 50% in the chamber when activated.

4. The pumping chamber shall have a grade level access large enough to allow servicing and/or removal of the largest component in the chamber. Access ports shall be protected against unauthorized entrance or removal.

5. The pumping chamber shall be vented through the grade level access or by means of a separate vent. In either case, the vent shall be equal to or greater than two times the diameter of the inlet port of the pump.

6. The pumping chamber shall be made of material resistant to the corrosive effects of wastewater and designed to withstand the lateral and bearing loads to which it is subjected.

7. All openings shall be sealed with a mastic, butyl rubber, or other pliable sealant that is waterproof, corrosive resistant and approved for use in contact with wastewater, in a manner to prevent the entrance of surface and groundwater.

V. Minimum Pump Specifications

1. Although timed dosed systems are preferred, an elevated sand mound may utilize either a timed dosed or on-demand dosing cycles. Each dose volume shall not exceed the estimated maximum daily flow divided by the number of dosing cycles.

2. The pump selected must be able to fully charge the distribution system without hydraulically overloading the absorption area.

3. The pump shall be constructed of corrosion resistant materials suitable for effluent pumping.

4. The pump shall be equipped with a low water cutoff to prevent damage to the pump during low water conditions.

5. The pump shall be sized per manufacturers' specifications to meet or exceed the hydraulic head of the system.

6. The pump shall be installed in compliance with the manufacturers' specifications so as not to violate pump warranty.

7. The suction and pressure lines shall be schedule 40 or equal and be sized to meet or exceed the hydraulic head of the system.

VI. Distribution System Specifications

1. The distribution system in an elevated sand mound shall consists of three components:

   a. a pressurized distribution manifold- that shall consist of a small diameter (1"- 1.5") schedule 40 pipe, to receive the effluent from the pump. This pipe shall be connected as to not create any dead ends, and shall have 3/8" holes drilled in it every 36" pointing up. See Figures 2 and 3. The effluent from the pump must come to the center of this distribution manifold and absorption area.

   b. field drain pipe to house the pressurized distribution manifold- A 4" field line pipe with the holes pointing down is acceptable. Other field drain pipe designs may be acceptable, but first must go through the experimental protocol.

c. distribution media- ½" to 2.5" gravel to a depth of 1' is acceptable. The design of the absorption area must comply with design guidelines for gravel underground absorption. If other distribution media is approved, they must comply with the appropriate regulations and guidelines.

Figure 2: SIDE VIEW OF DISTRIBUTION SYSTEM IN ABSORPTION AREA OF AN ELEVATED SAND MOUND

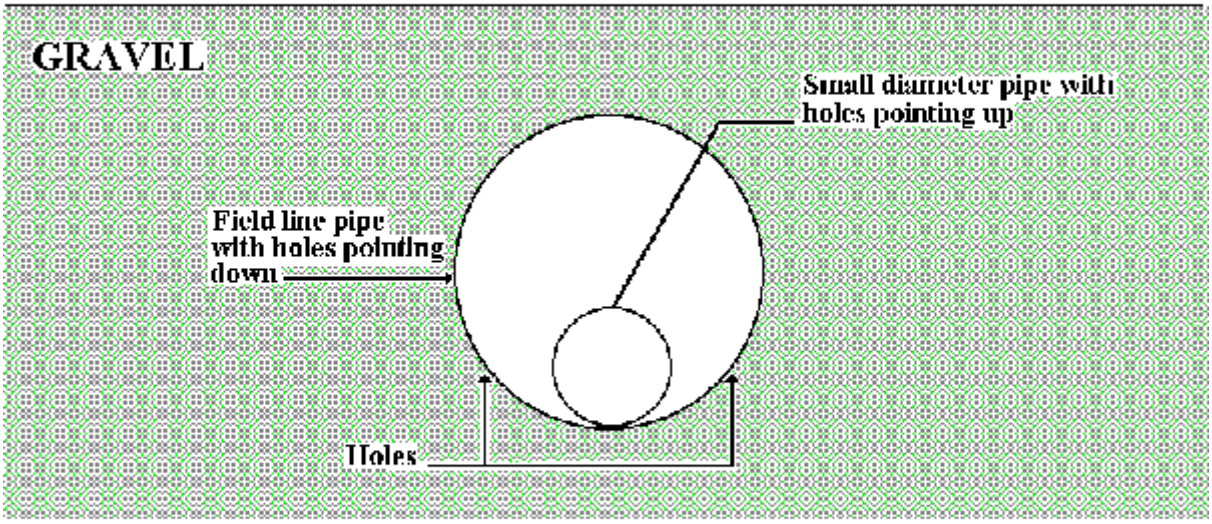
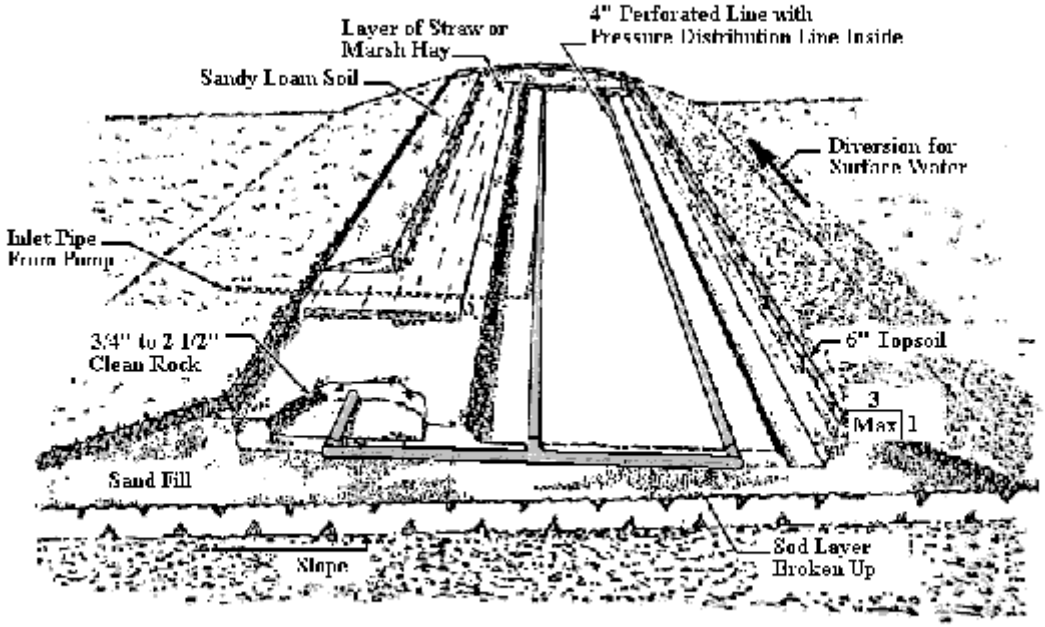


Figure 3: TOP VIEW OF ABSORPTION AREA WITH DISTRIBUTION NETWORK AND FIELD LINE PIPE.



VII. Site Requirements for Elevated Sand Mounds

It is not possible to outline every conceivable soil, site or design situation which may occur. The following section addresses basic criteria that every elevated sand-mound will need to follow.

1. Site conditions where elevated sand mounds are applicable:

    a. Permeable soils with high water tables:

    The elevated sand mound is useful in many difficult soils and can be effective in overcoming high water tables. In fact, the use of an elevated sand mound on permeable soils with high water tables may be the most practical use of this system. Whether the water table is seasonal or permanent, these soils have inadequate vertical separation to provide satisfactory treatment with conventional systems. The mound system addresses these conditions by elevating the absorption area to achieve the needed vertical separation. Passing the effluent through the filter media will result in a more thoroughly treated effluent, before it reaches the water table.

    b. Slowly permeable soils

    The elevated sand mound has an application on these soils, although may be costly due to the size of the basal area required. The elevated sand mound applies the effluent to the lighter textured top soil over a large area moving laterally until it is absorbed into the less permeable subsoil. On slowly permeable soils with high water tables, 5:1 side slopes are recommended.

    c. Excessively permeable soils

    These sites present the risk of inadequate wastewater treatment before it reaches unprotected aquifers. The elevated sand-mound system treats the wastewater to a higher level before it reaches the excessively permeable sub-soil.

2. Slope limitations with elevated sand mounds

Slope limitations for elevated sand-mounds are more restrictive than for conventional systems, particularly for mounds used on sites with slowly permeable soils. Elevated sand-mounds should not be considered on sites with slowly permeable soils and slopes of 6% or steeper. Elevated sand-mounds should not be considered on sites with permeable soils and slopes of 12% or greater. Figures 4 and 5 show how to place an elevated sand-mound on a flat and sloping site.

Figure 4

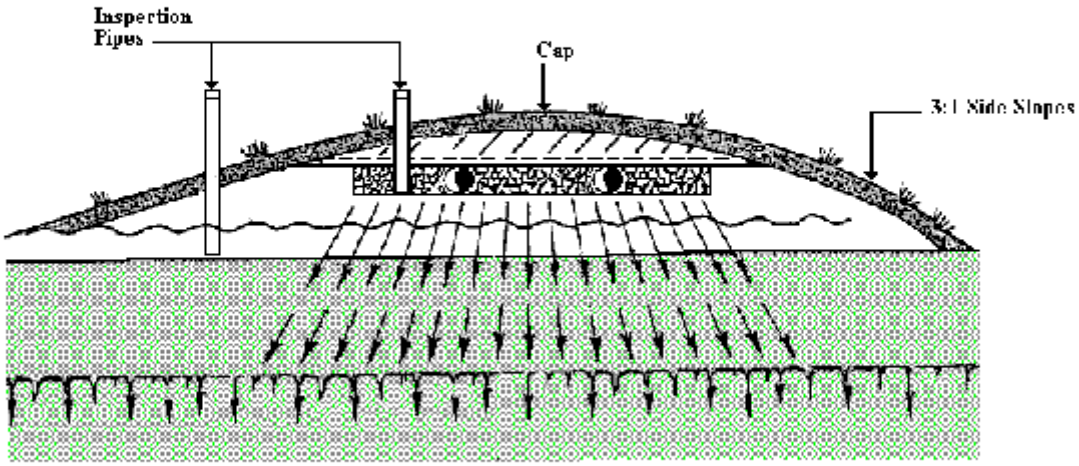
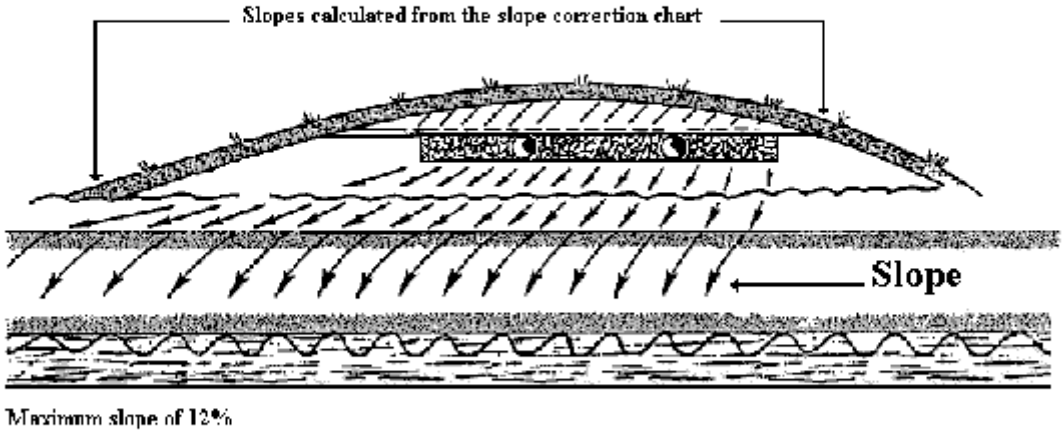


Figure 5



3. Minimum soil depth requirements - This is probably the most important factor determining how well the elevated sand-mound will function. If the soil has a restrictive horizon, the seasonal water table may not be any closer than 6 inches from the surface. If the soil does not have a restrictive horizon, the seasonal water table may not be any closer than 12 inches from the surface. If the restrictive horizon is not well defined, 12" of unsaturated soil is required. In all cases, there shall be a minimum of a 24" separation between the bottom of the absorption area and the water table.

4. Topography-Slopes - On permeable soils the maximum slope for the elevated sand-mound is 12%. On slowly permeable soils (light clay loam or heavier) the maximum allowable slope for the elevated sand-mound is 6%. A crest of a slope is preferred because the elevated sand-mound can be situated to allow flow in both directions away from the filled area. It is certainly preferred that the design allows for the effluent to flow away from the elevated sand mound.

   Level sites-Design should allow the effluent to flow in every direction away from the elevated sand-mound. On level sites with slowly permeable soils, effluent may have a tendency to stack under the absorption area that may result in surface seepage around the base of the mound. The elevated sand-mounds should be placed in areas that allow the effluent to flow away from the filled area.

5. Setback requirements- The set back requirements on Table 1 will be from the perimeter of the basal area, although no part of the system shall extend fully to a property line. The edge of the side slope must be at least 3 feet from a property line.

Table 1: Setbacks

	When the item setback from is uphill.	When the item setback from is downhill
Setback distances from property lines, driveways, buildings, ditches, etc.	10 feet	30 feet
Setback from wells	100 feet	Mound must be downhill from well on property. All other cases 100'.
Slope 8% or less for sensitive waters	Coarse to medium sand, fine sand, loamy sand, silty clay, clay	100 ft
Slope 8% or less for sensitive waters	Loam, silt, silt loam, sandy clay loam, silty clay loam, clay loam	50 ft

6. Reserve area- An area must be set aside to replace the elevated sand mound in the case of failure. Due to the nature of a mound failure the following criteria must be met:

   a. the area must be large enough to replace the entire system in a new untouched area.

   b. the area must meet all the initial requirements of the original mound system, including but not limited to soil conditions, water table restrictions and setback requirements.

   c. the area must not be used by property owner in a way which would adversely affect the placement of a new elevated sand mound system.

VIII. System Design

1. A soil and site evaluation must be performed on the lot. See also Section VII. The loading rate of the natural soil must be determined from Table 2:

Table 2: Soil loading rates

Soil Textural Class	Ribbon Length (inches)	EPA Manual Appl. rate gpd/ft^2
Gravel and Coarse Sand		1.2
Coarse to Medium Sand	-	1.2
Fine Sand, Loamy Sand	-	0.8
Sandy Loam	<.5	0.6
Loam	<.5	0.6
	.5-1	0.45
Silt Loam	<1	0.45
Sandy Clay Loam	1-2	0.45
*Silty Clay Loam or, *Clay Loam	1-1.5	0.30
	1.5-2.0	0.20

2. Determine the average daily flow from the residence:
Number of bedrooms X 150 gallons per day

3. Determining the size of the absorption area, basal area, side slopes, and maximizing length requirements:

   a. Sizing the absorption area- The absorption area size shall be determined by the **loading** rate of the fill material. The fill material shall be coarse sand, 0.5-1.0 mm (USDA designation), and is the same as concrete sand (Section S-703, MS Standard Specification for State Aid road and bridge construction). The **loading rate** of this material is 1.2 gallons per day per square foot. Note: A fill material as heavy as a light loam may be used, but this will change the size of the absorption area size. Use the appropriate **loading rate** of the fill to calculate the absorption area.

   Example:

   Given: 3 bedroom home @ 450 gallons per day

   450 gallons per day / 1.2 gallons per day per square foot = 375 square feet

Absorption area = 375 square feet

b. Sizing the basal area:

Using the information gathered from the soil and site evaluation, determine the loading rate of the natural soil withing two feet of the surface. Use the heaviest textured soil's loading rate to size the basal area.

Divide the average daily flow from the residence by the loading rate of the natural soil.

Example: Given: a three bedroom home @ 450 gallons per day
a natural soil of a heavy loam

450 gallons per day / .45 gallons per day per square foot =

1000 square feet basal area

c. Maximizing length of the elevated sand mound:

To the greatest extent possible, the elevated sand mound should be as long as possible. The length of the basal area and absorption area must always be at least 4 times the width. However, the width of the absorption area shall never be less than 2 feet.

d. Filter media depth:

There shall be a vertical separation between the seasonal water table and the bottom of the absorption area of at least 2 feet in every situation. This separation may include up to 12 inches of unsaturated natural soil.

e. Calculation of side slopes:

Side slope requirements will be different on level sites than on sloping sites. The side slope on the downhill side must be longer than the side slope going up hill. The following chart gives the correction factor on various slope conditions:

Table 3: Correction factors

slope as a percentage	downslope correction factor	upslope correction factor
0 %	1.00	1.00
2%	1.06	0.94
4%	1.14	0.89
6%	1.22	0.85
8%	1.32	0.81
10%	1.44	0.77
12%	1.58	0.74

Example: Given: 3' high mound with 9' side slopes placed on a 6% slope.
Table 3: Correction factors

Upslope side slope: 9' X .85 = 7.65' side slope

Downslope side slope: 9' X 1.22 = 10.98' side slope

Figure 6

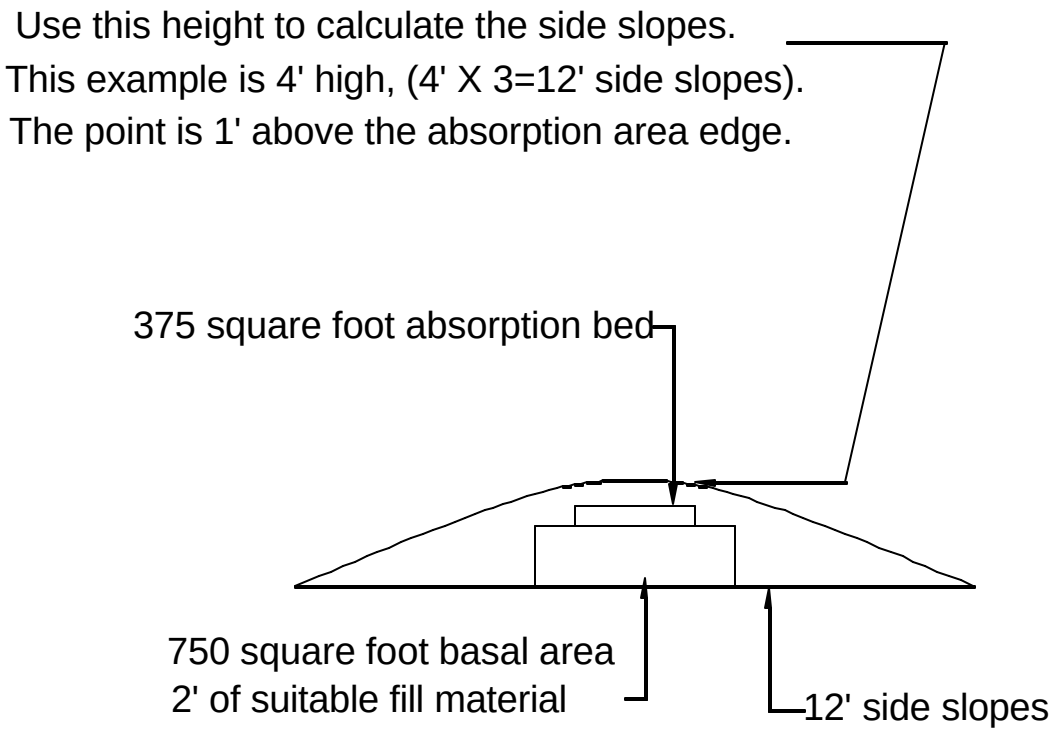
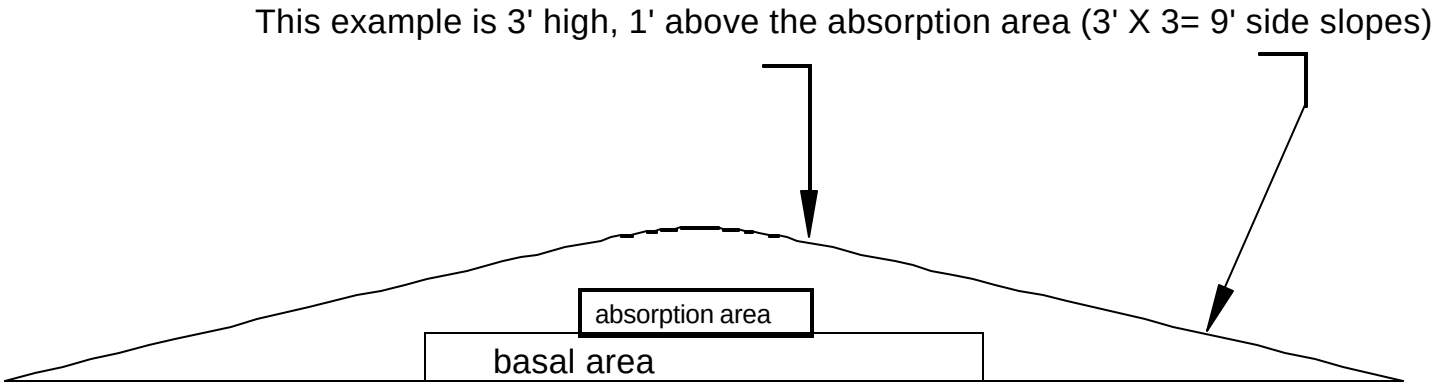


Figure 7



IX. System Placement

1. All components of the elevated sand mound system shall be located a minimum of:

   A. Five feet from any dwelling.

   B. Ten feet from any property line.

2. The aerobic treatment plant, septic tank, and pump chamber shall be located a minimum of 50 feet from any public, private or individual potable water source.

3. The elevated sand mound shall be located at a lower elevation and a minimum of 100' from any public, private, or individual potable water source.

4. Potable water lines shall not pass under or through any part of the elevated sand mound system. Where a water supply line must cross a sewer line, the bottom of the water service within ten feet of the point of crossing, shall be at least 12" above the top of the sewer line. The sewer line shall be of Schedule 40 pipe with cemented joints at least ten feet on either side of the crossing. Water and sewer lines shall not be laid in the same trench. The water and sewer lines shall maintain a minimum separation distance of ten feet.

5. The area for the mound or the replacement area shall not be used for vehicular traffic or vehicular parking.

6. Aerobic treatment plants, septic tanks, pumping chambers or disposal system shall not be placed under a dwelling or other permanent structure.

7. Elevated sand mounds shall not be located in depressed areas where surface water will accumulate. Provisions shall be made to minimize the flow of surface water over the disposal system area.

8. Elevated sand mounds located on slopes of less than eight percent shall have a minimum setback from recreational waters, shellfish waters or other sensitive areas as prescribed in Table 4.

9. Elevated sand mounds located on slopes of greater than eight percent or greater shall be located a minimum of 100 feet from recreational waters, shellfish waters and other sensitive areas.

10. Where all or part of the elevated sand mound is proposed to be installed on property

other than the owner's, an easement in perpetuity shall be legally recorded in the proper county.
The easement shall be of sufficient area to permit access, construction and maintenance of the elevated sand mound.

11. No site for an elevated sand mound or replacement area shall be located wholly within an area which is frequently flooded, swamp, marsh, or wetland. Except that if permits have been issued by the proper regulatory agency authorizing the use of wetlands for building sites and the installation of an individual onsite wastewater disposal system. The property shall be evaluated using standard soil and site criteria for IOWDS.

12. When a proposed lot is located partially within a frequently flooded area, that portion of said lot not within the flood prone area may be considered for approval for the elevated sand mound.

13. A minimum of 6 (six) inches of naturally occurring soil must be present above a restrictive horizon or a predominantly gray soil before placement of any fill.

14. Easements or right-of-way areas for utilities, surface or subsurface drainage, roads, streets, ponds or lakes shall not be used as available space for an elevated sand mound.

X. Construction

1. Site Preparation

Good construction techniques are essential if the mound is to function properly. The following techniques should be considered:

Step 1: Rope off the site to prevent damage to the area during other construction activity on the lot. Vehicular traffic over the area should be prohibited to avoid soil compaction.

Step 2: Stake out the mound perimeter and bed in the proper orientation. Reference stakes set some distance from the mound perimeter are also required in case the corner stakes are disturbed.

Step 3: Cut and remove any excessive vegetation. Trees should be cut at ground surface and the stumps left in place.

Step 4: Measure the average ground elevation along the upslope edge of the bed to determine the bottom elevation of the bed.

Step 5: Install the delivery pipe from the dosing chamber to the center of the mound. Lay the pipe below the frost or slope it uniformly back to the dosing chamber so it may drain after dosing. Back fill and compact the soil around the pipe.

Step 6: Plow the area within the mound perimeter. Use a two bottom or larger moldboard plow, plowing 7 to 8 in. (18 to 20 cm) deep parallel to the contour. Single bottom plows should not be used, as the trace wheel runs in every furrow, compacting the soil. Each furrow should be thrown upslope. A chisel plow may be used in place of a moldboard plow. Roughening the surface with backhoe teeth may be satisfactory, especially in wooded sites with stumps. Rototilling is not recommended because of the damage it does to the soil structure. However, rototilling may be used in granular soils, such as sands.

Plowing should not be done when the soil is too wet. Smearing and compaction of the soil will occur. If a sample of the soil taken from the plow depth forms a wire when rolled between the palms, the soil is too wet. If it crumbles, plowing may proceed.

2. Fill Placement

Step 1: Place the fill material on the upslope edges of the plowed area. Keep trucks off the plowed area. Minimize traffic on the downslope side.

Step 2: Move the fill material into place using a small track type tractor with a blade. Always keep a minimum of 6 in. of material beneath the tracks of the tractor to minimize compaction of the natural soil. The fill material should be worked in this manner until the height of the fill reaches the elevation of the top of the absorption bed.

Step 3: With the blade of the tractor, form the absorption bed. Hand level the bottom of the bed, checking it for the proper elevation. Shape the sides to the desired slope.

3. Distribution Network Placement

Step 1: Carefully place the coarse aggregate in the bed. Do not create ruts in the bottom of the bed. Level the aggregate to a minimum depth of 6 in. (15 cm).

Step 2: Assemble the distribution network on the aggregate. The manifold should be placed so it will drain between doses, either out the laterals or back into the pump chamber. The laterals should be laid level.

Step 3: Place additional aggregate to a depth of at least 2 in. (5 cm) over the crown of the pipe.

Step 4: Place a suitable backfill barrier over the aggregate.

4. Covering

Step 1: Place finer textured soil material such as clay or silt loam over the top of the bed to a minimum depth of 6 in. (15 cm).

Step 2: Place 6 in. (15 cm) of good quality topsoil over the entire mound surface.

Step 3: Plant grass over the entire mound using grasses adapted to the area. Shrubs can be planted around the base and up the sideslopes. Shrubs should be somewhat moisture tolerant since the downslope perimeter may become moist during early spring and late fall. Plantings on top of the mound should be drought tolerant, as the upper portion of the mound can become dry during the summer.

5. Operation and Maintenance

a. Routine Maintenance

A properly designed and constructed mound should operate satisfactorily with virtually no regular maintenance.

b. Rehabilitation

Three failure conditions may occur within the mound. They are (1) severe clogging at the bottom of the absorption area, (2) severe clogging at the fill material and natural soil interface, and (3) plugging of the distribution network. Usually these failures can be easily corrected.

If severe clogging occurs at the bottom of the absorption bed, its cause should first be determined. If it is due to failure to maintain the pretreatment unit, hydrogen peroxide to oxidize the accumulated organics at the infiltrative surface could be used. The chemical can be applied directly to the bed or through the dosing chamber. Because of the danger in handling this strong oxidant, this treatment should be done by professionals.

If the clogging is due to overloading or unusual wastewater characteristics, efforts should be made to reduce the wastewater volume or strength. It may be necessary to enlarge the mound. The mound cap should be removed and the aggregate in the absorption bed stripped out. The area downslope of the mound should be plowed and additional fill added to enlarge the mound to the proper size. The absorption bed can then be reconstructed.

Severe clogging at the fill and natural soil interface will cause surface seepage at the base of the mound. This area should be permitted to dry and the downslope area plowed. Additional fill can then be added. If this does not correct the problem, the site may have to be abandoned.

Partial plugging of the distribution piping may be detected by extremely long dosing times. The ends of the distribution laterals should be exposed and the pump activated to flush out any solid material. If necessary, the pipe can be rodded.